

Summary of Research

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Space Education Initiatives, Inc.
P.O. Box 12263
2830 Ramada Way Suite 203
Green Bay WI 54304
- 6) Grant number: NAG5-12532
- 7) Copies of this report have been sent to the following NASA offices:

Larry Bilbrough- Technical Officer
NASA Headquarters, Code FE
Washington, DC 20546-0001

Gerald T. Smith- Administrative Grant Officer
Office of Naval Research
Chicago Regional Office
230 South Dearborn Avenue, Room 380
Chicago, IL 60604-1595

Harold Coleman, Grant Officer
NASA/Goddard Space Flight Center
Code 210.G
Greenbelt, MD 20771-0001

NASA Center for Aerospace Information- CASI
Attn: Document Processing Section
7121 Standard Drive
Hanover, MD 21076

WISCONSIN EARTH AND SPACE SCIENCE EDUCATION

The Wisconsin Earth and Space Science Education project aligns itself closely with NASA's Implementation Plan for Education. The programmatic activities of the Wisconsin Earth and Space Science Education project closely relate to the NASA Teacher/Faculty Preparation and Enhancement Education Program. The project embraces the NASA philosophy of, "*Using NASA mission, facilities, human resources, and programs to provide exposure to teachers and faculty, to support the enhancement of knowledge and skills, and to provide access to NASA information in science, mathematics, technology, engineering, and geography.*" Specifically the project goals are:

1. To increase student performance in Earth and Space Sciences
2. To prepare Wisconsin students for jobs in the 21st century
3. To increase technology integration into classroom instruction as a tool for enhanced student learning
4. To promote and advance systemic change within Wisconsin by working closely with other science and professional development efforts within the state

These goals will be met by successfully completing the following objectives.

Objective 1: Provide teachers in Wisconsin with access to a comprehensive portfolio of Internet-based Earth and Space Science instructional materials.

Objective 2: Implement a professional development model that maximizes the use of these materials within schools in Wisconsin, Alabama and Iowa.

This summary of educational activities will describe how Space Education Initiatives and its partners met these two objectives.

Curriculum Portfolio

Curriculum Portfolio Evaluation

754 Wisconsin educators actively use either the web-based curriculum portfolio, or printed materials from the portfolio that were used during teacher workshops.

- 45% used the website more than seven times
- 57% used printed materials between 4 and 10 times during
- 71% gave the professional development workshops the highest rating of “excellent”
- 90% said the materials from the professional development workshops was good or excellent for practical classroom use
- 88% said that the use of technology based math/science resources was beneficial

There are a total of ten lessons or programs that were primarily used by participants. These lessons are K-3 Space, Orbital Laboratory, Mission Solar System, Lesson Database, Can a Fish Swim in Space, Exploring the Universe with Light, Gravity, Air Powered Rockets, Exploring the Solar System, Linked NASA Resources, and Global Positioning Kits. Participants could make multiple choices on all of the units they have used in their classroom. Of these ten lessons, the following statistics show the top five that were used:

1. 59% Air Powered Rockets (81users)
2. 54% Linked NASA Resources (75 users)
3. 38% Exploring the Solar System (53 users)
4. 34% Lesson Database (47 users)
5. 27% K-3 Space (37 users)

The least used units were Exploring the Universe with Light (11%), Global Positioning Kits (20%), and Can a Fish Swim in Space (22%). Other units that were used and individually cited by participants included: JPL/Goldstone/Online visits with NASA (5 users), ETO/heat shield (3 users), and hot air balloons (2 users). If participants were not using WIMSTE materials at all it was due primarily to time constraints (65%). These constraints were defined as needing more time for research, curriculum development,

peer conversations, and alignment of WIMSTE materials to existing science curriculum that the school provides.

Teachers were also asked about the engagement, achievement, and experience of students who used resources provided through this project. The following student impacts were found:

- 74% of teachers reported students were more engaged and active in WIMSTE math/science lessons as compared to traditional math/science lessons delivered by teacher lecture
- 73% of teachers reported students increased engagement in WIMSTE lessons resulted in a positive impact on their math/science achievement test scores
- 67% of teachers reported that problem based learning (67%), technology (60%), and multi-modality learning (40%) had the greatest positive impact on students when participating in math/science lessons

Professional Development Opportunities

Summer Space Academies

158 teachers from around the state participated in the five summer 2003 “Space Education Academies” held throughout Wisconsin. These week long workshops included activities such as air powered rocket launchers, simulated space flights, building and flying hot air balloons, participating in plant growth experiments aboard the International Space Station and exploring “earth –to – Orbit lab activities. Staff members from Space Education Initiatives instructed educators on how to best implement these standards based earth and space science curriculum pieces into their K-12 classrooms. Many of these hands-on science activities were based on past, current, and future NASA missions.

Participants had many positive comments about the materials they received and the activities of the workshop and felt that access to all materials via the website was crucial for implementation in their classrooms. It should be noted that many of the participants received recognition in their local media for participation in this workshop.

Minnesota Science and Technology Education Workshop

12 teachers from the Minneapolis area participated in the July, 2002 “Minnesota Science and Technology Education Workshop held at the University of Minnesota in Minneapolis. The week long workshop included activities such as air powered rocket launchers, simulated space flights, building and flying hot air balloons, participating in plant growth experiments aboard the International Space Station and exploring “earth –to – Orbit lab activities. Staff members from Space Education Initiatives instructed educators on how to best implement these standards based earth and space science curriculum pieces into their K-12 classrooms. Many of these hands-on science activities were based on past, current, and future NASA missions.

On the evaluation participants listed the most popular activities of the week as building the air powered rocket launchers and the planet size comparison activity. Participants felt that the construction of hot air balloons was too time consuming for their classrooms and would e better suited to an after school enrichment program.

Milwaukee Space Day

In August 2002, the Space Education Initiatives (SEI) staff conducted a three day workshop with 18 educators from the Milwaukee Public School (MPS) District. Professional development, curriculum, instruction, and web-based materials on space science, science, and math were the primary focus areas for participants of this three day workshop. As a result of this workshop, educators were expected to utilize the new content, strategies, and materials in their respective classrooms during the 2002-2003 academic year. This evaluation report reflects participant’s opinions on the August 2002 workshop and how well they were able to use information from the workshop during classroom activities in 2002-2003.

Evaluation Design

The evaluation was conducted through the use of a web based survey distributed from the Zoomerang (www.zoomerang.com) website. This survey had 14 questions which were created to elicit both qualitative and quantitative responses from survey participants. The survey was initially distributed to 18 total participants on May 13, 2003. The survey

closed on June 16, 2003. Surveys were distributed via the Zoomerang website to 15 participants through their email addresses. The survey was also distributed via U.S. mail and fax to three survey participants who did not have an email address. Two follow up phone calls and two reminder emails were also given to survey participant's to increase the response rate of the survey during this 5 week period. The survey questions and participant database can be forwarded to you at your request.

Evaluation Results: Participant Demographics

83% of respondents attended three and/or two days of the August 2002 workshop at MPS conducted by SEI staff. These 14 respondents taught a total of 2,215 students per year. 33% of respondents taught science as their only subject and an additional 33% taught science in combination with another subject area. Survey respondents had an average of 13 years experience teaching. 50% of the participants taught elementary students in grades PK-5th grade. 27% of the participants taught middle school students in 6th-8th grade. 55% of the respondents were male and 45% were female.

Evaluation Results: Participant's Survey Responses

The survey included 14 questions that focused around five main areas: (1) participants workshop experience; (2) utilization of workshop experience in real classroom during the academic year; (3) changes in teacher content knowledge of science, space science, and math; (4) student behaviors pertaining to science, space science, and math activities; (5) and changes in student content knowledge of science, space science, and math. These questions included both qualitative and quantitative responses from the 8 survey respondents. Quantitative responses from survey respondents included:

- 63% said that students achieved at higher levels during lessons that modeled what they learned at the SEI workshop than when they taught in a more traditional manner
- 88% stated the workshop was excellent or good
- 75% stated increased competency in space science and learning strategies to teach space science

- 75% stated using the materials in their classrooms since the August 2002 workshop
- 50% stated using additional web-based materials in their classrooms that they learned about from the August 2002 workshop
- 63% said their students showed increased interest, participation level, and engagement in science activities when the August 2002 workshop materials were used in their classrooms
- 43% said that their students show decreases in inappropriate classroom behavior when their teachers used science lessons and materials taught to them from the August 2002 workshop
- 43% said that they were able to teach to the diverse learning styles in their classroom during science class when the August 2002 materials and lessons were used

Qualitative replies from survey respondents were based on the use of SEI materials; the types of SEI materials used; and provided constructive comments on how the SEI workshops could be more useful to the participants. 33% of respondents stated they did use SEI training and materials between one and ten times during the academic year. SEI topics used in classrooms by these respondents included: Black History Month (astronauts and scientists), astronomy, planets, stars, space flight, space science (in general), solar system, rocket launcher, planet size and distance, force, and friction. 16% of respondents said they did not use the materials because they were not the principal science teacher in the school or classroom. A request for more lessons specific to primary elementary and intermediate elementary grades was suggested.

Next, we surveyed participants about their use and types of online SEI materials they used. 22% of respondents stated that they did use the online SEI materials that were introduced to them from the August 2002 workshop between one and three times during the academic year. Topics that online materials were most used for were astronomy and astronaut units. Time constraints served to be the primary reason for not using the online materials even more. On the other hand, 22% of respondents stated that they did not use the online SEI materials in their classroom during the academic year after the August

2002 SEI workshop. Reasons for not using online materials is that there were enough printed materials in stock, did not have enough time for online research, and that online research and science lesson/unit planning was done during the summer months.

Last, six survey respondents offered August 2002 workshop reactions and provided constructive feedback on how SEI could improve their workshop offerings. Those comments included:

- Enjoyed the hands-on practice and articles
- Request for a more in-depth workshop for participants who already have a good knowledge base of space science. Perhaps a beginner and then intermediate workshop to address different experience and content levels of science.
- Online forum and discussion questions was thought provoking and very helpful in demonstrating shared knowledge and in sharing new knowledge
- Using hands-on science activities like SEI has is very good for inquiry based science lessons that our district is using
- Great workshop, very hands-on and informative—keep free items coming to educators

Summary of Findings

The Wisconsin Earth and Space Science Education project successfully met its objectives of creating a comprehensive online portfolio of science education curricular resources and providing a professional development program to increase educator competency with Earth and Space science content and teaching pedagogy. Overall, 97% of participants stated that their experience was either good or excellent. The favorable response of participant reactions to the professional development opportunities highlights the high quality of the professional development opportunity. The enthusiasm generated for using the curricular material in classroom settings was overwhelmingly positive at 92%. This enthusiasm carried over into actual classroom implementation of resources from the curricular portfolio, with 90% using the resources between 1-6 times during the school year. The project has had a positive impact on student learning in Wisconsin. Although direct measurement of student performance is not possible in a project of this kind, nearly 75% of participating teachers stated that they saw an increase in student

performance in math and science as a result of using project resources. Additionally, nearly 75% of participants saw an increase in the enthusiasm of students towards math and science. Finally, some evidence exists that the professional development academies and curricular portfolio have been effective in changing educator behavior. More than half of all participants indicated that they have used more hands-on activities as a result of the Wisconsin Earth and Space Science Education project.